Sediments precipitated from the purification of mine water from the solid phase contained suspension, before their discharge to surface waters, are collected in surface or underground settling tanks. During several decades of mining plant operation, it is possible to deposit as much as approx. 150 000 tons of sediment in a single settling tank. In the southwestern part of the Upper Silesian Coal Basin, the geological structure and hydrogeological conditions are conducive to processes that, as a result of mining activities, lead to the formation of sediments characterized by an increased content of radioactive nuclides. Sediments deposited in underground mining goafs do not affect the environment because after filling a specific, limited space designated for storage, the collected material remains underground. In the case of surface settling tanks, there is a need to manage the sediments in order to maintain the permeability of the mine drainage system. Management of sediments through storage may pose a serious problem in terms of radiological protection of the environment.

The sediments are a mixture of many minerals – quartz, clay minerals, feldspars, carbonates, sulphates and iron compounds. Previously conducted sediment studies within the framework of the Silesian Centre for Environmental Radiometry of the Central Mining Institute in Katowice showed that the main source of radioactive nuclides is barite due to the geochemical affinity of radium and barium ions. Considering the amount of sediment accumulated in a single settling tank and the fact that the average content of barite in the sediments is 20%, and sometimes, due to sedimentation conditions, the amount of barite in some areas of the settling tank can reach 40%, the development of appropriate methods for beneficiation of barite would be justified economically and pro-ecologically.

The aim of this work was to determine the possibilities of obtaining barite concentrate. On the one hand, purification of the barite sediment was to enable obtaining material for further research aimed at isolating radium for further use in medicine. At the same time, removing radioactive nuclides from barite would allow the use of this mineral in many industries. On the other hand, purification of the deposited material from barite as a source of radionuclides would enable the use of the sediment as a mineral mixture, mainly quartz and clay minerals, in construction. In the case of successful results, the above activities would become an excellent example of a so-called "zero waste" solution.

As part of the subject work, detailed mineralogical, chemical and radiometric studies of the sediment were conducted. Division of the sediments collected from the mine water settling tank of the KWK ROW Ruch Jankowice mine into fractions and the analyses performed showed that the content of barite, and thus radioactive nuclides, increases with decreasing grain size. The size of the grains also determined the amount of quartz in the individual fractions, i.e. the smaller the grains, the lower the content of the above mineral. The contents of clay minerals in the individual fractions did not differ significantly. Based on the conducted chemical studies, it was found that the strontium content in the sediment samples was in the range of 0,8-3,0%. Mineralogical studies showed that, apart from the most common form of barite $BaSO_4$, a form containing strontium was present in all sediment samples, i.e. the so-called strontium barite $BaSrSO_4$.

Barite beneficiation was carried out using the flotation method. Direct flotation was carried out in two stages. In the first stage, barite collectors were used for flotation tests in doses from 100 g/t to 2000 g/t and at different pH values of the process environment (from pH

6 to pH 10). In the second stage, tests were conducted using collectors in specific doses, regulating the amount of depressant and the pH value of the process environment. As part of this work, reverse flotation and cleaning flotation tests were also carried out. Based on the barite contents determined using the XRF and XRD methods, it was found that the XRD method is an accurate method for determining not only the mineral phases present in the samples, but also the contents of individual minerals. Therefore, the barite content in all concentrates and waste obtained as a result of flotation tests was determined using the XRD method.

Based on the conducted studies, it was found that direct flotation using appropriate collectors or collectors in a configuration with a depressor allows for obtaining concentrates containing a maximum of approx. 65% barite. However, the barite concentrates were characterized by a low yield value, usually not exceeding 40%. In the case of reverse flotation, aimed at concentrating barite in waste and, on the other hand, obtaining concentrates of gangue minerals with the smallest possible amount of barite as a source of radionuclides, tailings containing approx. 50% barite was obtained, and barite recovery exceeded 90%. The gangue mineral concentrates were characterized by a quartz content of more than 80% and the recovery exceeded 80%. At the same time, the minimum barite content in the gangue mineral concentrate (quartz concentrate) did not exceed 5%. The radiometric studies conducted showed that despite the low barite content in the quartz concentrates, the concentration of radionuclides exceeded 1000 Bq/kg, which is the maximum concentration allowing for the commercial use of the sediments.

In addition, cleaning flotations were carried out, both on barite concentrates obtained in direct flotation tests and on concentrates of gangue minerals. This method did not significantly affect the significant increase in the values of parameters describing the effectiveness of the process.

Moreover to the flotation method, the effectiveness of barite beneficiation was also tested using other physical or chemical methods. However, these methods proved to be ineffective.

The results of analyses of radionuclide content in selected concentrate samples characterized by varied barite content showed consistency with the results of preliminary tests of the feed constituting the material for beneficiation. The content of radionuclides was closely related to the content of barite in the samples of obtained concentrates and tailings.

The use of the results of the work on an industrial scale requires conducting research to optimize the technological process on a semi-technical scale. It would be more beneficial from an economic point of view to conduct work on improving the quartz flotation beneficiation process in order to obtain a product characterized by a low barite content and thus a lower radioactive concentration of radium, enabling its use in construction and limiting the amount of waste containing barium and radium requiring appropriate storage (disposal) methods or constituting a raw material for obtaining radium. Further research would allow obtaining a quartz concentrate with an even lower barite content, and thus a lower concentration of radioactive nuclides not exceeding 1000 Bq/kg, which is the maximum concentration allowing for the commercial use of sediments without restrictions resulting from the principles of radiological protection.